

National Plan for Advanced Automotive Technologies

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Background

The Office of Advanced Automotive Technologies (OAAT) was established, in March 1996, to consolidate all of the Department's light vehicle technology research and development efforts into an integrated Advanced Automotive Technologies (AAT) Program. The OAAT is part of the Office of Transportation Technologies within the Department of Energy's Office of Energy Efficiency and Renewable Energy. Upon its creation, the OAAT initiated an intensive activity to develop a comprehensive multi-year plan to define the scope, focus and content of the AAT Program for the period of calendar years 1997 through 2001. Experienced teams from the OAAT staff and the DOE national laboratories were assembled to develop the plan through a collaborative process, which included workshops and internal peer reviews. This effort culminated in the development of a preliminary draft National Plan for Advanced Automotive Technologies.

This preliminary draft of the National Plan is being reviewed by OAAT's industry customers and stakeholders, the national laboratories, and other federal agencies. Comments on the preliminary draft will be considered during the preparation of a final draft which will be provided to the National Research Council (NRC) for an independent peer review. The National Plan will be published upon completion of the NRC peer review.

Goals and Objectives

The **goal** of OAAT is to research, develop, and validate technologies that will enable domestic market introduction of light vehicles (i.e., automobiles and light trucks) which have:

- several times the fuel economy of current, comparable conventional vehicles,
- fuel flexibility,
- emissions that comply with statutory limits projected to be in place when the vehicles are available for the marketplace, and
- other attributes, such as price, that render them competitive with conventional products.

The **objectives** of the OAAT are to develop and validate the following:

- automotive propulsion subsystem technologies which will enable the achievement of **50 miles per gallon** in a test-bed six-passenger sedan by 1998;
- technologies which will enable the use of compressed natural gas as an **alternative fuel** in conventional automobiles, to achieve full range and performance capability by 1999;

- battery technologies which will render **full-range electric automobiles** commercially viable by 2003;
- automotive technologies which will enable the achievement of **80 miles per gallon** in a six-passenger sedan that could be successfully marketed by 2008;
- technologies which will enable the use of ethanol as an **alternative fuel** to achieve 80 miles per gallon (gasoline equivalent) in demonstration automobiles by 2008; and
- automotive technologies that use non-petroleum-based fuels and achieve zero emissions while obtaining **100 miles per gallon** in lightweight vehicles that could be marketed by 2015.

Overall Strategy

The OAAT strategy for achieving its objectives is focused on the research, development, and validation of energy-efficient **technologies** as the OAAT final products. These products will include validated technologies for vehicle systems, advanced heat engines, fuel cells, high-power energy storage, power electronics and electric machines, advanced automotive materials, alternative fuels, and electric vehicle batteries. Many of the broad spectrum of AAT Program efforts support the goals and objectives of the government/industry Partnership for a New Generation of Vehicles (PNGV). The OAAT fully acknowledges that, with due consideration to market dynamics and corporate business strategies, it is the industry's role to pursue the validated technologies through production, marketing, and final use by the intended customer. To provide maximum probability that this will occur, OAAT has placed special emphasis on the involvement of industry in the planning, integration, and implementation of its AAT Program.

The OAAT approach to implementing the AAT Program emphasizes jointly funded partnerships with industry to develop and validate technologies. This will ensure that (a) the nation's best resources are applied to these R&D activities, (b) maximum technology transfer will take place, and (c) government resources are leveraged by those of industry.

Description

The National Plan for Advanced Automotive Technologies is a roadmap toward an updated approach to the Department's conduct of automotive technology R&D. This new approach is based on conducting DOE-sponsored automotive technology R&D activities in an interdependent, integrated fashion to assure that the spectrum of resultant technologies (1) are mutually compatible and practical in a complete vehicle system context, and (2) can be combined into a hypothetical vehicle system with vehicle-level attributes commensurate with AAT Program objectives. A period of time will be required to complete the transition to this new approach since many R&D activities currently in progress may have to be adjusted or redirected. This transition process is well under way and will be completed as expeditiously as possible. The National Plan is a living document. Accordingly, it will be updated as required.

This is a long-range planning document and, as such, it is not tailored to explicit budget levels. However, in a general sense, the spectrum of technology research, development, and validation activities reflected in this National Plan have been conceived to be implemented within realistic, plausible budget levels. Annual implementation documents,

prepared to be consistent with and in support of this National Plan, will be budget-driven and comply with actual appropriated budgets.

In the event that appropriated budget levels will not support all of the activities reflected in this National Plan, available funding will be concentrated on the highest-priority technical barriers in the development path of the subject technologies. Should the appropriated budget levels be too low to support this “barrier-focused” approach for all of the subject technologies, R&D of one or more of the subject technologies may have to be terminated. The process by which this technology down select will be accomplished, should it become necessary, will be defined in annual program implementation document(s).

Scope

The *National Plan for Advanced Automotive Technologies* addresses nine technology areas for application in light vehicles. Research in these nine technology areas is needed to develop and validate the technologies that will enable the vision of decreased light vehicle petroleum use to be achieved. These technology areas are:

- Vehicle Systems (systems definition, modeling, and hybrid platform)
- Advanced Heat Engines (gas turbine, piston engine)
- Fuel Cells (power subsystems, fuel processors and fuel storage)
- High-Power Energy Storage (batteries, ultracapacitors, and flywheels)
- Power Electronics and Electric Machines (inverters/controllers and motors)
- Advanced Automotive Materials (lightweight materials)
- Alternative Fuels (compressed natural gas, alcohols, propane, and dimethyl ether)
- Electric Vehicle (EV) Batteries (research to meet mid- and long-term technology goals)
- Exploratory Technology Research (longer-term, cross-cutting research)

Each of these nine technology areas is described in separate sections of the National Plan. Each of the sections provides a brief overview of the status of the technology, technology area goals and objectives, technical challenges of each technology, and a research plan to overcome the technical barriers to commercially viable technologies.

The attached figure illustrates the pathways for integration of the technology area R&D efforts to meet the objectives of the Office of Advanced Automotive Technologies (OAAT). The Vehicle Systems Technology Area provides the focus for most of the AAT Program. All technology development activities that fall under the purview of this vehicle systems focus are “system driven” (i.e., the focus and targets of these activities are derived from a common, integrated vehicle system definition to assure that, when developed, each technology will be practical within the context of a realistic automobile). Additionally, to ensure maximum return on investment, available resources are barrier-focused (i.e., concentrated on the most critical technical barriers in the technology development path). In certain areas where the technological and economic risks are highest, multiple technological options are pursued with appropriate reduction of the number of options as strengths and weaknesses of candidate concepts become apparent.

Both petroleum and alternative fuels will be used to meet the technical targets for advanced vehicle technologies. Alternative fuels also will be used in conventional, spark-ignition engine vehicles. EV battery research focuses exclusively on the development of advanced battery technologies, the principle constraint in the commercial viability of EVs.

Exploratory technology research consists of research that (1) supports the removal or attenuation of technical barriers to the successful development of advanced automotive technologies but (2) is too high a risk to be included in the technology development critical paths. Particular emphasis is placed on long-term research and research that addresses cross-cutting generic problems. Exploratory technology research provides a bridge between government-wide fundamental research activities and applied R&D efforts.

During the 1997-2001 timeframe of this initial version of the National Plan, the OAAT strategy emphasizes development of energy-efficient, petroleum-based propulsion technologies. Concurrently, electric vehicle battery and alternative fuels technologies will be developed and validated. During the years subsequent to 2001, the strategy will shift emphasis to automotive technologies that will enable the efficient use of inherently-clean alternative fuels.

ADVANCED AUTOMOTIVE TECHNOLOGIES PROGRAM

Technology R&D Integration Pathway

